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Assessing the impact of random corrections of the atmospheric component in seasonal predictions with CNRM-CM

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Seasonal forecasting systems often exhibit strong systematic errors and poor reliability. These aspects can be partly compensated by a posteriori forecast bias correction and calibration techniques, but numerous studies have shown that accounting for model uncertainties during the model integrations further tackles these issues. This study presents a method designed for the ARPEGE-Climate atmospheric component of the CNRM-CM seasonal forecasting system, called "stochastic dynamics", which consists in randomly perturbing the model prognostic variables with corrections for long-term model errors previously estimated by weakly nudged runs. The perturbations are drawn separately for each ensemble member, but consistently between the variables (e.g. corresponding to the same estimation in the nudged run).

Two different frequencies for sampling the model corrections and drawing the perturbations during the forecast have been tested in cross-validation mode over a 34-year boreal winter re-forecast period, starting from November 1st initial conditions and running up to 4 months forecast times. One ensemble uses monthly mean error corrections derived from other years of the nudged run and randomly drawn each month for each ensemble member, whereas another tests the use of random 5-day sequences of corrections. A comprehensive assessment of the impact of the method on seasonal forecast quality will be provided, based on a variety of deterministic and probabilistic scores, and using a reference ensemble re-forecast with initial perturbations only as a benchmark. The perturbation technique has contrasted effects depending on the region and variable of interest, however improvements in the representation and predictability of the North Atlantic mid-latitudes circulation are found. At a seasonal time scale, both sampling methods seem to have very similar effects on forecast quality, mainly related to improvements in the model mean state. Future work therefore includes combining stochastic dynamics with other perturbation approaches.